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ABSTRACT

This paper presents a model for conducting educational job analysis and the field test of that model on ten teaching fields. This model was tested for its ability to job analyze a teaching field's content knowledge according to federal employment guidelines. Differences between teaching and other job fields meant that actual time spent on a skill would likely be an unreliable procedure for establishing the importance of skills for assessing job competence. Approximately 250 content objectives were rated for job-relatedness by currently practicing teachers. Job-relatedness was defined by two 5-point rating scales of the time spent teaching and the objective and the extent of essentiality of the objective. Results showed that the correlations between the time and essentiality dimensions were significant. In all fields objectives were clearly ranked in terms of relative job-relatedness. Of particular interest is the actual content identified in each teaching field as most relevant to the job. In all fields, basic skills emerged strongly as the emphasis. This was true even within the more advanced courses in each field. (Author)

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BASIC CONTENT SKILLS REQUIRED AND THE JOB ANALYSIS METHODOLOGY UTILIZED FOR TEACHER CERTIFICATION

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One of the requirements of an applicant for an initial teaching certificate in the state of Georgia is a satisfactory demonstration of content knowledge competence. Other aspects of the certification process deal with the assessment of on-the-job skills, teaching behaviors, attitudes, and knowledge of teaching methodology. This procedure will be applied to the following ten teaching fields: Early Childhood (K - 4), Middle Childhood (4 - 8), Communicative Arts (7 - 12), Social Studies (7 - 12), Mathematics (7 - 12), Home Economics (7 - 12), Industrial Arts (7 - 12), and Agriculture (7 - 12). The current concern is the accurate, legally defensible measurement of subject matter content competence. The Equal Employment Opportunities Commission (EEOC) among other federal agencies such as the Justice and Labor Departments mandate that instruments used to license or certify job applicants must measure skills empirically demonstrated as job-relevant and necessary for successful job performance. To this end, these federal agencies have published guidelines to be followed in the development and implementation of licensing procedures.

The overall procedure that was used to identify the appropriate skills to be included in licensing in this project was to initially specify the full range of teaching field content knowledge expected for successful job performance. A second step was to verify that these skills were in fact required for on-the-job performance. Some skills were expected to emerge as more critical than others and some may actually not be required for successful job performance.

The initial domain specification was done by committees of Georgia educators who represented a variety of constituents. The

verification that these content skills were required for successful performance was accomplished through the job analysis.

There are several job analysis models which have been previously developed and successfully used (Butler, 1972; Fine, 1965; Fleishman, 1967). However they have been primarily used to analyze jobs in occupational settings. These procedures measure clearly defined, observable tasks which are often repetitive and occur with high frequency over a limited time period. These tasks are identifiable by a brief job description (Lawshe & Balma, 1966) and their importance can be analyzed in terms of actual time spent in job performance (Hill & Schmidt, 1976).

A job analysis model for content knowledge in a teaching field must be sensitive to the fact that content knowledge skills may not be repetitive and often occur irregularly over an extended time period. For example, a teacher may cover an important concept three or four times over the course of the year, while, in contrast, a secretary performs important job tasks several times over the period of a week. This difference between teaching and other job fields means that actual time spent on a particular skill (or content field) is likely to be an unreliable (and in some cases unfeasible) procedure for establishing the importance of a skill in assessing job competence.

A further consideration is that content knowledge cannot be clearly and reliably job analyzed from topic descriptors. Instead, instructional objectives must be used to specify the full intent of the skill involved. A final consideration is that an educational job analysis identify only required content knowledge and not peripheral

or related skills (such as teaching behaviors).

Method

Design and Subjects

The job-relatedness of the teaching field objectives was identified through a large scale survey. Respondents to the survey were currently practicing teachers. In each of the fields except Industrial Arts and Agriculture, approximately 280 teachers were sampled. A multi-stage probability sampling design was used to select participants. The number of teachers selected in each field adequately represented teachers from large and small schools, urban and rural districts, various geographic locations and grades taught.

Procedures

Each teacher sampled was sent a survey booklet containing about 250 teaching field content objectives. They were asked to give a rating of the job-relatedness of each objective they had taught the past year. The focus on having taught the objective during the current year was to standardize the framework from which each teacher would respond. For only the objectives the teacher had actually taught, he/she provided two ratings. The first rating was that of the amount of time spent teaching that objective relative to other objectives taught that year. The second rating was a measure of the extent of essentiality of the objective. Five-point rating scales were used for both the time and essentiality dimensions. (An example of the rating form used is attached.) Depending on the number and kinds of courses taught during the past year, the

number of objectives that each respondent rated varied. Follow-up letters and phone calls were made to increase survey responses.

Results

There are two distinct kinds of results to be reported. One includes the indicators of the success of the adapted job analysis model. These indicators are response rates, correlations among dimensions rated and numbers of positively identified teaching field objectives. Another type of results include the actual content skills identified by job incumbents as critical for successful job performance. Both of these results will be presented.

Results of Use of Model

One important concern was whether the job analysis model, adapted for use here, would successfully discriminate among content skills that were critical and those that were not critical for performance on the job. Consequently some ordering of objectives on either or both dimensions would be preferred. Further, the importance of each dimension would need to be established. The empirical consistency of ratings across the "time" and "essentiality" ratings would provide indication of the weighting of each dimension.

Finally, the actual number of respondents who rated each objective provided an additional source of information about the importance of the content knowledge rated.

The following table presents the response rates of each teaching field

survey, the correlation between the two dimensions for each objective and the correlation between the number of respondents and each dimension for each teaching field. Within each field the means for time and

Results of Job Analysis for 10 Teaching Fields

Teaching Field	Response Rates	Corr./Time & Essen.	Corr./No. of Resp. & Time	Corr./No. of Resp. & Essen.
Early Childhood	77%	.72*	.47*	.55*
Middle Childhood	74%	.66*	.59*	.73*
Communicative Arts	62%	.64*	.57*	.58*
Social Studies	53%	.22**	.69*	.49*
Mathematics	72%	.60*	.28*	.18*
Science	60%	.70*	.39*	.36*
Business	71%	.68*	.54*	.43*
Home Economics	73%	.61*	.35*	.25*
Agriculture	67%	.56*	.19**	.20*
Industrial Arts	47%	.68*	.69*	.59*
		*p < .001		**p < .01

essentiality were computed separately, across all respondents on an objective by objective basis. In each teaching field exhibiting excessive variability across respondents' ratings for essentiality, scores were standardized to better view the actual differences in objectives' ratings.

Correlations between time and essentiality were significant and

allowed for considering the dimensions of equal importance in eventual objectives' selection. Correlations of ratings (on time and essentiality) with number of respondents indicate a consistency between the importance of an objective described by its ratings as well as by the sheer number of instructors who teach the objective. In all fields, except one (Industrial Arts) there was about 70% overlap between the content initially identified by Georgia educators as important and the objectives rated important by the survey respondents.

Because the response rates in all fields, except Industrial Arts, were quite high compared to prefessional standards for mail survey results (typically ranging about 30% to 40% with follow up; Erdos, 1970) the researchers are confident of the representativeness of the results for the state. Further, confidence intervals (95%) were computed for each mean rating for both time and essentiality for each objective. (Because of the amount of output required to report these 5000 confidence intervals, they have not been appended to this paper.)

Results of Content Selection

Because of the high correlation between ratings for time spent teaching and for essentiality of an objective, one variable could have been used to determine the importance of each content objective. Both variables were used however, so as not to obscure the objectives with differing ratings on time and essentiality. The composite means (not combined) were used to represent each objective. The ratings were graphed on two dimensional axes ranging from +5 to -5. (In the fields in which the essentiality ratings were standardized, scores on this dimension

ranged from +1 to -1.) The graphic representation of results clearly displayed these objectives that were of more or lesser importance compared to other teaching field objectives.

The job analysis results provided an initial step in determining the actual parameters of the testing instruments. One requirement for a good test is that it be content valid. That is, the items must adequately measure the domain of skills. As a result, a test to be used for a science (grades 7 - 12) certificate, for example, cannot be composed strictly of biology items even if these skills have been empirically proven to be very job-relevant. The content of the test must map to the content of a domain of skills shown to be job-related. Larger sections of the domain should be proportionately represented on the test.

The actual objectives for which items would be written to comprise the final test were selected in the following way. Of the entire set of original objectives that were job analyzed, those shown to be not job-related were eliminated. Of the remaining job-relevant content objectives, the most essential (and most widely used/taught) were identified. These were mapped across the span of content in the teaching field. Underrepresented areas of content were supplemented with the next most job-related objectives. Content overlap of objectives also limited numbers of objectives required in some areas. As a result, the objectives selected to define the test were distributed across the domain proportionally, from "importance" restrictions from job analysis results and from size of content subsections of the domain. The meshing of job analysis results and subdomain size varied across teaching fields.

At this point in the test development process, all legal guidelines had been satisfied. An extensive review of critical skills required for successful job performance has been conducted and those job requirements have been delineated. Test blueprints have been made based on an accurate definition of the content domain and the demonstrated importance of each of these content skills.

Content Skills Identified

In general, in all fields, basic skills emerged as the most essential and most frequently taught content. This was true even within the most advanced courses within a field. Each of the teaching fields will be described below with the content topics identified as critical for success on the job. Due to contractual arrangements, specific selected objectives cannot be disseminated at this time.

Early Childhood (K - 4)

As could be expected, the emphasis in this area emerged in Language Arts and Mathematics with nearly equal attention devoted to each of these areas. Science and Social Studies are equally represented but considerably less than the two areas mentioned above. Other areas with lesser emphasis are Art, Music, Health, Physical Education and outdoor recreation.

Middle Childhood (4 - 8)

Four major content areas were selected for inclusion on this test. Of the four, the emphasis is placed on Language Arts, while Mathematics, Social Studies, and Science are also highly represented.

Communicative Arts (7 - 12)

Areas identified prior to job analysis emerged quite similarly following the empirical study in this field. Primary emphasis remained on literature, composition, reading, and language. Other content subsections include logical reasoning, research techniques, media, communications careers, and oral communications.

Social Studies (7 - 12)

American government and political science received the most emphasis, while economics, history, behavioral science, and citizenship were also highly represented. Other areas included are Georgia studies and geography.

Mathematics (7 - 12)

Major emphasis was placed on algebraic structures, followed by geometry, measurement trigonometry analysis, sets, numbers and numeration, probability, logic, operations, properties, and number theory. Some attention was also given to computer applications.

Science (7 - 12)

Biology, followed by matter, scientific processes, earth sciences, and physics clearly defined the necessary science content skills.

* * * * *

The remaining four areas, all encompassing grades 7 - 12, are vocational fields. While there was some original skepticism (not on the part of the researchers) about the ability or appropriateness of the definition of content skills for certification in these areas,

the model was successful and the results follow.

Business (7 - 12)

General business information and office skills were identified as most essential. Business math, communications, and accounting were very important. Also included are record keeping, business law, organization, and professional business group content.

Home Economics (7 - 12)

Easily identified as critical to job performance is content knowledge in the following broad areas; food, clothing, housing, human development, and family and consumer education and management.

Agriculture (7 - 12)

Agricultural mechanics was identified for primary emphasis. Animal science, livestock and poultry management and production, plant science, soil science, soil and water management, forestry, horticulture, natural resources, and agribusiness were proportionately represented.

Industrial Arts (7 - 12)

The original teaching field identification for Industrial Arts was shown to be inappropriate by the job analysis results. Content initially specified was not considered essential nor was it taught to any appreciable extent in the state. The field was redefined, job-analyzed a second time, and the critical job-relevant content emerged as follows; dimensioning, tools, drawings, magnetism, electricity, communications, printing, metals, soldering, welding, and petroleum.

Conclusions and Recommendations

The results of the field test indicate that the model for job analysis successfully accommodates the special needs of performing job analyses in educational fields. In nine of ten teaching fields the fact that few objectives received very low composite ratings and/or were rated as having been taught by too few respondents verify the success of the initial step of domain specification. The adaptation of the absolute time dimension to the relative time dimension used here was successful. Ratings effectively discriminated among objectives in terms of time spent teaching.

Due to significant correlations between dimensions, equal weight was assigned to each dimension for use in selection of the most job-related objectives.

Since not all teachers rated each objective the number of respondents became an additional factor in considering the importance of objectives. Therefore, high correlations between the number of respondents and the ratings on each dimension indicated that the scales had accurately assessed the job-relevancy of objectives and that the most important, job-related objectives could be identified with the highest composite means.

The usefulness of this model for job analysis lies in its ability to initially identify job-relevant tasks and to empirically establish those which are legitimate to include in test development for teacher certification, consistent with the guidelines of the EEOC.

In addition to considering the data, content coverage must be

analyzed for establishing the content validity of the test instrument. The objective means and correlations describe the field in terms of actual current teaching skills and relationships among skills and are used in mapping content of selected objectives across the domain. Objectives can also be factor analyzed by the ratings for use in insuring coverage by selected objectives across the domain.

The most specific need for this project was that the job analysis model empirically identify content knowledge critical for job performance. This is a necessary first step in developing valid licensing exams. [A job analysis is not, however, sufficient to satisfy federal guidelines for test development. The author has done extensive research on the legal and technical issues of validating tests according to the EEOC. Because of the length and complexity of that issue, it is the subject for a separate paper.]

An indirect benefit of the job analysis was that it served as a needs assessment for state department of education decision-makers. The job analysis verified (or did not verify) the content they anticipated students were being taught. In all fields, it provided the most comprehensive assessment of what is taught to students in the course of a year. It gave insight for examining student statewide test scores, and served as a realistic description of the content of education in the state.

The success of the job analysis model was shared by the researcher, the EEOC, the state and answered the needs of many of the state's educators.

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CONTENT INVENTORY

A. **If Taught:** Check (✓) only the objectives that you have taught this year.	B. **Time Spent Teaching:** For each checked (✓) objective, rate the time spent teaching it this year. Use the following scale: 1 = very little time 2 = little time 3 = moderate amount of time 4 = much time 5 = very much time	C. **How Essential:** For each checked (✓) objective, rate the extent to which the objective is essential to your teaching field. Use the following scale: **Essential:** 1 = to a very little extent 2 = to a little extent 3 = to a moderate extent 4 = to a great extent 5 = to a very great extent

Objective Number	Objective	A. Check (✓) If Taught	B. Time Spent Teaching (Rate 1-5)	C. How Essential (Rate 1-5)
19	Identify interesting unsolved problems in mathematics such as four-color map conjecture and Fermat's last theorem.			
20	Describe the topological properties of one-sided surfaces such as the Moebius strip.			
21	Identify the properties of point sets which are invariant under transformations such as reflections, rotations, translations, dilations, and sheers.			
22	Identify the symmetries (line, point, plane) of given geometric figures and identify group structures of simple symmetries such as those of a square and equilateral triangle.			
23	Recognize congruent figures and name the isometry which maps onto the other.			
24	Identify the properties of similarity relation in geometric figures.			
25	Identify plane point sets such as half planes, rays, segments, angles and closed curves (include points inside, on and outside closed curves).			
26	Explain the roles of undefined terms, definitions, and axioms in geometric proof.			
27	Identify steps in simple synthetic proofs in a euclidean setting using direct and indirect proofs.			

CONTENT INVENTORY

A. **If Taught:** Check (✓) only the objectives that you have taught this year.	B. **Time Spent Teaching:** For each checked (✓) objective, rate the time spent teaching it this year. Use the following scale: 1 = very little time 2 = little time 3 = moderate amount of time 4 = much time 5 = very much time	C. **How Essential:** For each checked (✓) objective, rate the extent to which the objective is essential to your teaching field. Use the following scale: **Essential:** 1 = to a very little extent 2 = to a little extent 3 = to a moderate extent 4 = to a great extent 5 = to a very great extent

Objective Number	Objective	A. Check (✓) If Taught	B. Time Spent Teaching (Rate 1-5)	C. How Essential (Rate 1-5)
28	Apply theorems on circles and lines related to circles in proofs and problems.			
29	Use basic constructions to determine locus of points satisfying one or more conditions.			
30	Apply geometry in the solution of problems in everyday life such as scale drawings, tessellations, and inaccessible distances.			
31	Recognize the role of the parallel postulate in the development of non-euclidean geometry.			
32	Identify a reflection as the basic isometry of a plane (distance-preserving, one-to-one mapping of the plane onto itself).			
33	Identify rotation, translation, or glide reflection as the composition of reflections.			
34	Use matrices to represent transformation.			
35	Apply the concepts of similarity and congruence to problems of indirect measurement and design.			
36	Use two and three coordinate systems in describing points, lines, and planes.			
37	Find distance between points, lines, and planes in a coordinatized space.			
38	Choose a suitable set of axioms and use a coordinate proof for appropriate theorems.			

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